



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) Publication number:

0 408 228 A2

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number: 90307207.2

(51) Int. Cl. 5: H01L 23/498, H01L 23/13

(22) Date of filing: 02.07.90

(30) Priority: 11.07.89 GB 8915827

(71) Applicant: OXLEY DEVELOPMENTS CO., LTD.  
Priory Park  
Ulverston Cumbria LA12 9QG(GB)

(43) Date of publication of application:  
16.01.91 Bulletin 91/03

(72) Inventor: Chambers, Jeffrey, Dr.  
Bay Cottage, Main Street, Baycliffe  
Nr. Ulverston, Cumbria, LA12 9RN(GB)  
Inventor: Smith, David John  
Roundtre, Fernleigh Road  
Grange-Over-Sands, Cumbria, LA11 7HT(GB)

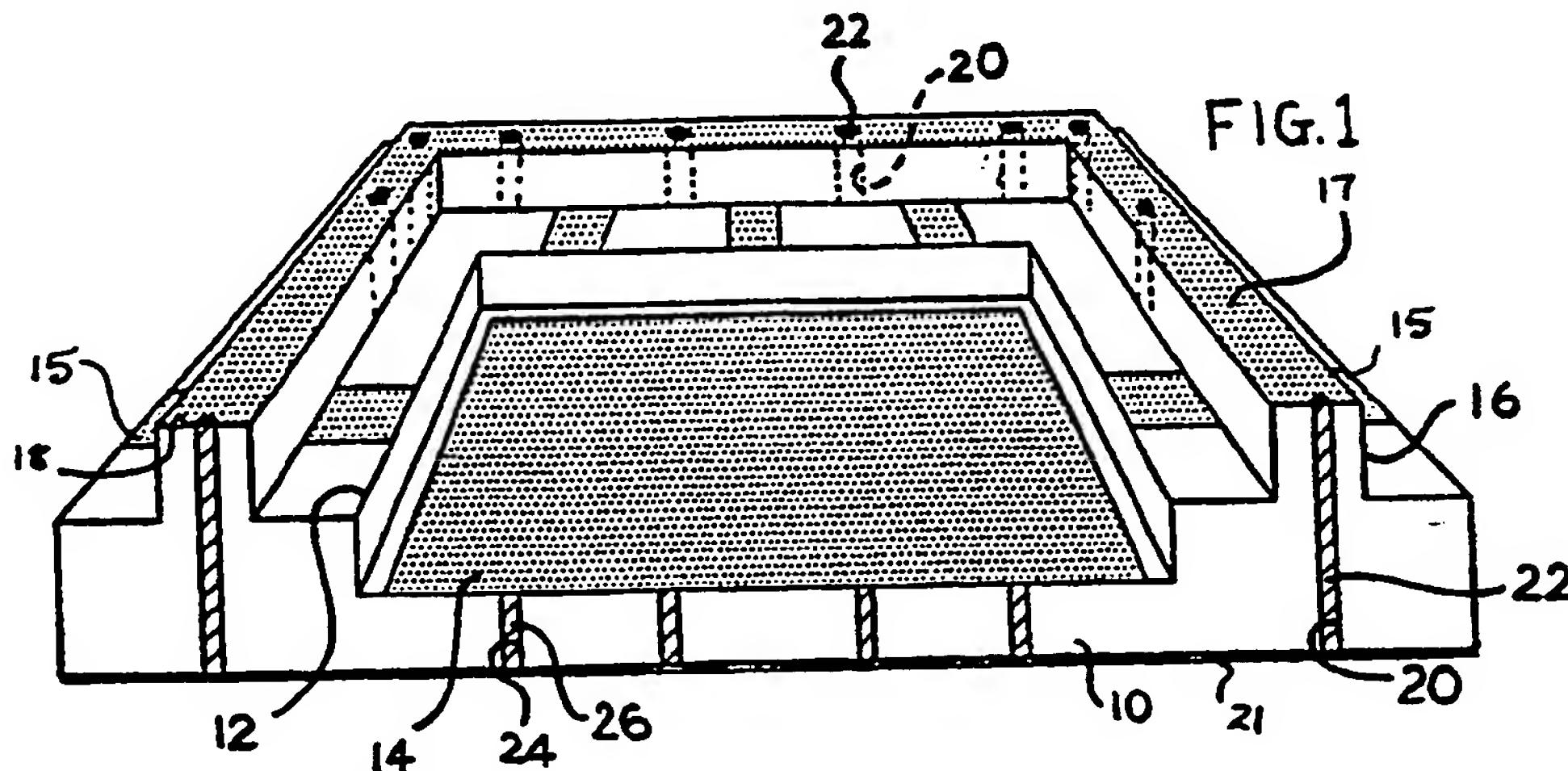
(84) Designated Contracting States:  
DE FR GB

(74) Representative: Huntingford, David Ian et al  
W.P. THOMPSON & CO. Coopers Building  
Church Street  
Liverpool L1 3AB(GB)

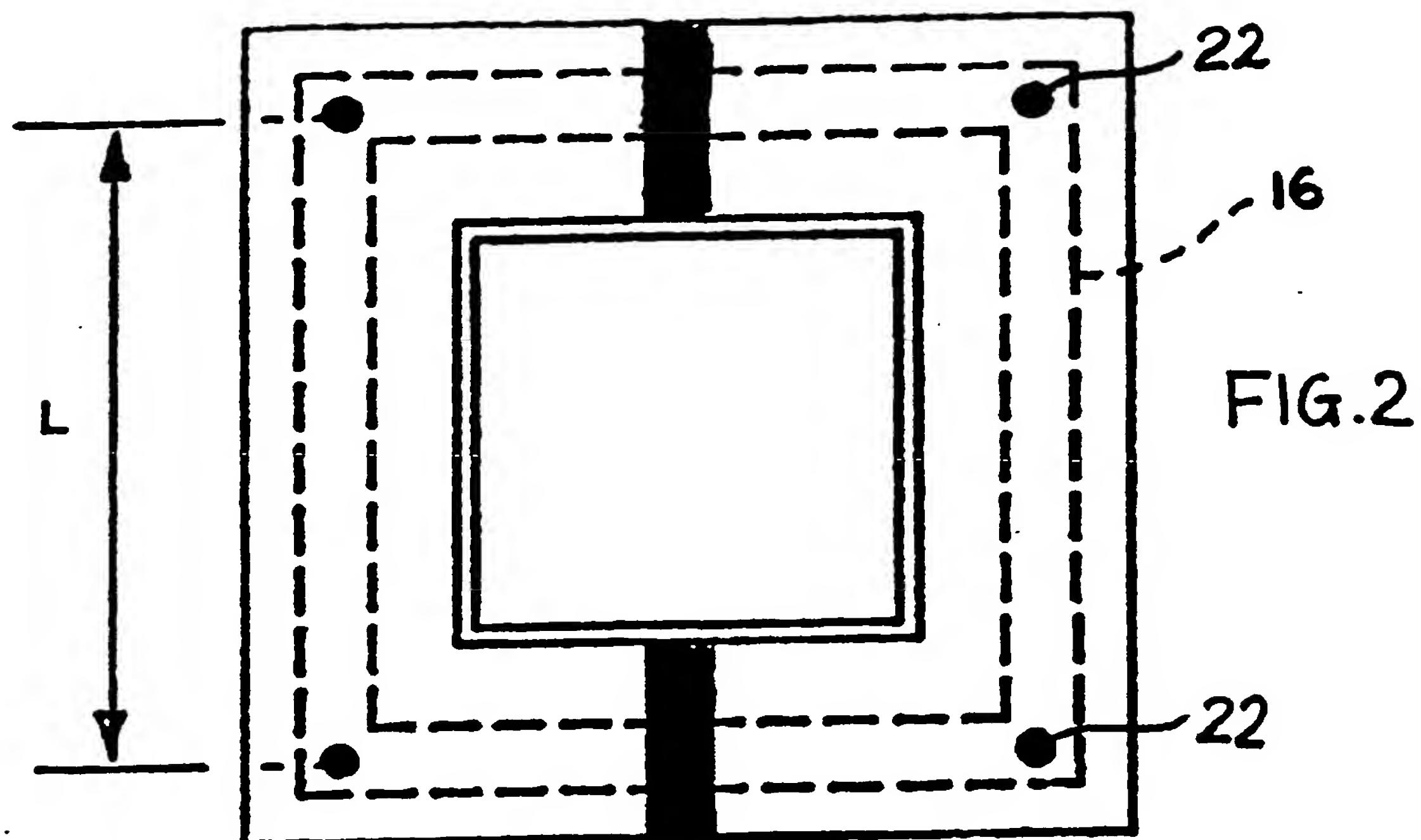
### (54) Ceramic package and component.

(57) A ceramic package component has a base portion (10) and an upstanding enclosing wall (16) on the base portion (10), the upper surface (18) of the wall (16) being provided with an electrically conductive coating (17) in order to receive a lid sealingly thereon. The electrically conductive coating (17) on the upper surface of the wall (16) is electrically

connected to a further conductive coating (21) on the undersurface of the base portion (10) by means of a high density array of conductive vias (22) extending through the wall (16). The inter via spacing between adjacent vias (22) is preferably less than one quarter of the wavelength of the frequency at which the component is to operate.



EP 0 408 228 A2



## CERAMIC PACKAGE AND COMPONENT

The present invention relates to ceramic package components, for the housing and protection of semi-conductor chips, of the type comprising a base portion and an upstanding enclosing wall on the base portion, the upper surface of the wall being provided with an electrically conductive coating in order to receive a lid sealingly thereon.

Hermetic packages provide the necessary environmental protection for semiconductor chips to ensure reliable, long term operation of the chip. At high frequencies, packages fabricated from metals are normally utilised for their inherent grounding of the metal package wall structure to ensure a good microwave performance. However, the use of ceramic packages is preferred, if they are able to provide the necessary electromagnetic protection, since a hermetically sealed package can be reliably produced using ceramics.

It is thus an object of the present invention to provide a ceramic package which can be used in electromagnetic environments where previously it has been necessary to use a metal-based package.

The use of conductive vias extending from a die attachment area within the package interior to a conductive area on the base of the package is already known. However, in such known packages, only a small number of such vias, maybe two or three, have been used.

It is also known (EP 260 370) to use conductive vias to connect respective external terminator pins to conductive interconnection layers within the die area. Such vias therefore form part of the internal circuitry of the package.

It has now been discovered that the resonant frequency of the package, and hence the frequency at which the package can be operated, can be increased considerably, by electrically connecting said electrically conductive coating on the upper surface of the wall to a further conductive coating on the undersurface of the base portion by means of a high density array of conductive vias extending through the height of the wall.

Preferably, the inter via spacing ( $d$ ) between adjacent vias in the array should be much less than one quarter of the wavelength at the operating frequency.

In this way, the electrically conductive coating which may be in the form of a metallised layer and which acts as a lid seal is grounded, enabling a ceramic package embodying the aforementioned component to be used in high frequency environments.

The present invention also includes a ceramic package comprising a ceramic package component as hereinbefore defined.

By way of example only, specific embodiments of the present invention will now be described, with reference to the accompanying drawings, in which:-

5 Fig.1 is a perspective view, partly cut-away, of a first embodiment of ceramic multilayer package component for a semiconductor device, in accordance with the present invention;

10 Fig.2 is a plan view of a second embodiment of ceramic multilayer package component for a semiconductor device; and

15 Fig.3 is a plan view of a third embodiment of ceramic multilayer package component for a semiconductor device, in accordance with the present invention.

20 Referring firstly to Fig.1, a multilayer ceramic package component comprises a rectangular base 10 (only three sides of which are shown) which is provided with a central rectangular recess 12 defining a semiconductor die attachment area 14. A rectangular wall 16 (only three sides of which are shown) is located on top of the upstanding portions of the base 10. In use, a semiconductor die is attached onto the die attachment area 14 and a rectangular lid is secured to the upper end of the rectangular wall 16, thereby providing a hermetically sealed multilayer ceramic semiconductor package.

25 The multilayer ceramic package component is constructed using known tape casting techniques, and various selected layers can be coated with a conductive layer, for example by means of screen printing. For example,  $50\Omega$  microstrips 15 extend underneath the wall 16 on the upper surface of the base 10 and also the upper surface 15 of the wall 16 is provided with a metallic coating to enable a good seal with a lid to be obtained.

30 It will be noted from Fig.1 that the die attachment area 14 is coated with a conductive metal layer. In accordance with a known technique, a plurality of conduits 24, punched when the component is in the green state and filled with metal to provide conductive vias 26, extend from the die attachment area to the undersurface of the base 10. This feature is particularly useful since the conductive vias 26 rapidly conduct heat away from the die attachment area 14, which allows the ceramic package to be used for both small signal devices and for power devices.

35 Referring now specifically to the upper surface 18 of the wall, in order to provide a good high frequency performance, especially in the microwave region, ( $\geq 18$  GHz) the metallised lid seal must be grounded. This is achieved by punching a plurality of conduits 20 from the top of the wall 16 to the undersurface of the base 10 when the compo-

ment is still in the green (unsintered) state and then filling the conduits with metal to provide conductive vias 22 extending from the metallisation layer 17 on the top of the wall 16 to the metallisation layer 21 beneath the base 10. The component is then fired in the normal way. In use, the undersurface of the base 10 will be grounded, thus efficiently grounding the lid seal by virtue of the conductive vias 22 passing through the wall 16 and the base 10.

In practice, ceramic packages manufactured using co-fired technology normally have an upper frequency limit for electrical grounding purposes, dependent upon the physical dimensions of the package. For example, for an embodiment constructed as shown in Fig.2, (which is otherwise identical to the Fig.1 embodiment).provided with only four conductive vias 26 extending from the upper surface of the wall 16 to the undersurface of the base 10, one via at each corner of the wall 16, the upper frequency limit of the package is governed by the distance L between adjacent conducting vias 26 becoming equal to an electrical quarter wavelength of the input frequency.

In order to overcome the above problem, the spacing of the conductive vias 26 is reduced, as shown in Fig.3, so that a high density array of vias is provided.1 embodiment.

Thus, in the preferred Fig .3 embodiment there is a multiplicity of closely spaced vias 22. In order to raise the effective resonant frequency  $f_{max}$  of the package the spacing (d) of adjacent vias 22 should preferably satisfy the expression

$$d \leq \frac{\lambda}{4}$$

where  $\lambda$  is the wavelength within the dielectric medium of the package corresponding to the operating frequency f ( $f_{max} = \lambda_{max}$ ).

It will be noted also that external metallisation of the package to achieve grounding is not now required.

Moreover, the conduits which are subsequently filled to form the conductive vias may be punched in pairs or higher multiple groups to increase the density of the vias and thereby reduce the inductance of the ground connection even further.

By use of the present invention to provide multiple high density conductive integral vias to ground the package wall structure, it is possible to obtain a co-fired multilayer ceramic package with extended operating frequency into the microwave region (18 GHz and beyond) suitable, for example, for gallium arsenide and high speed silicon integrated circuits.

base portion (10) and an upstanding enclosing wall (16) on the base portion (10), the upper surface (18) of the wall being provided with an electrically conductive coating (17) in order to receive a lid sealingly thereon, characterised in that said electrically conductive coating (11) on the upper surface (18) of the wall is electrically connected to a further conductive coating (21) on the undersurface of the base portion (10) by means of a high density array of conductive vias (22) extending through the height of the wall.

2. A ceramic package component as claimed in claim 1, wherein the inter via spacing between adjacent vias (22) in the high density array is less than one quarter of the wavelength of the frequency at which said component is to operate.

3. A ceramic package comprising a ceramic package component as claimed in claim 1 or 2.

20

25

30

35

40

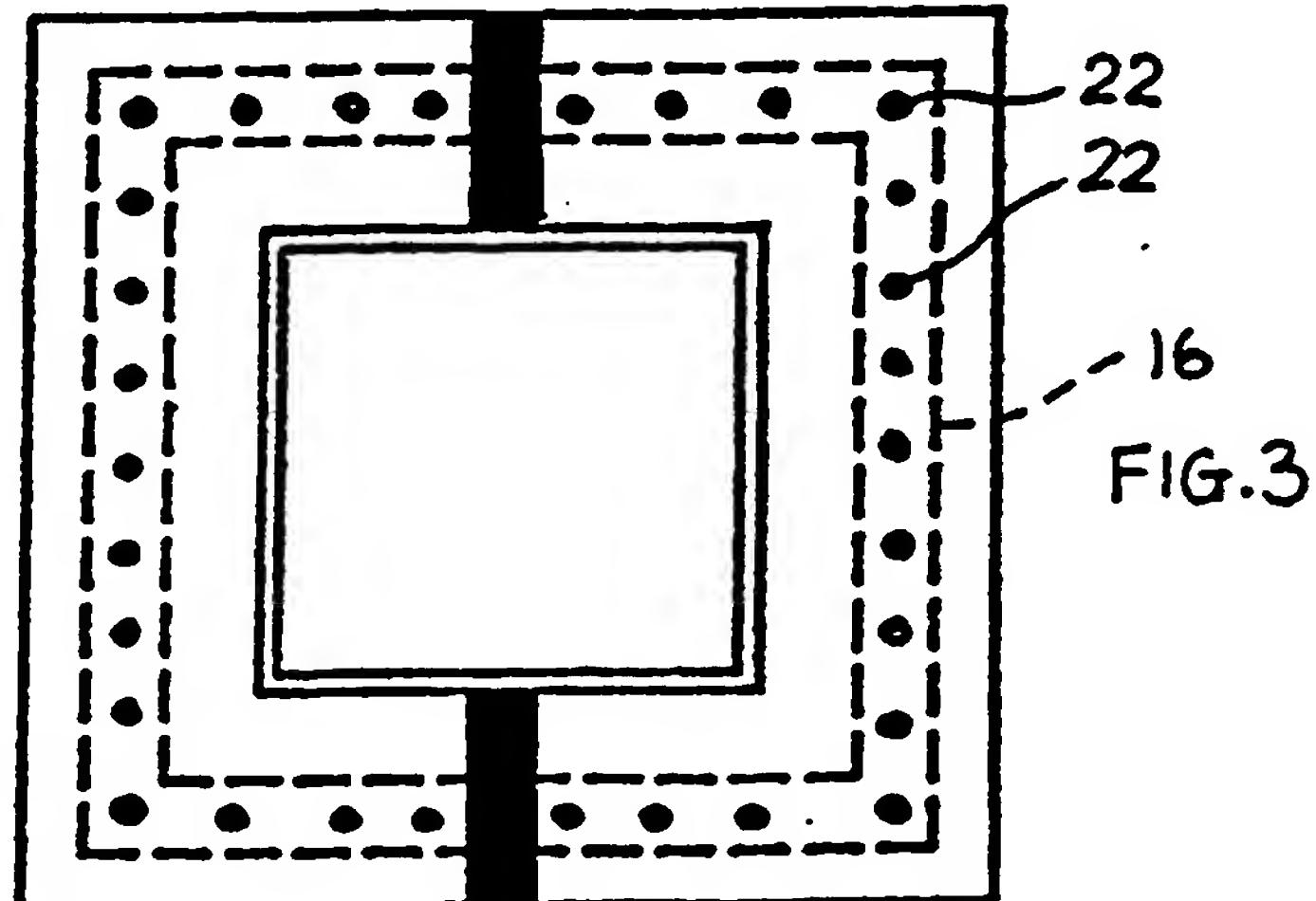
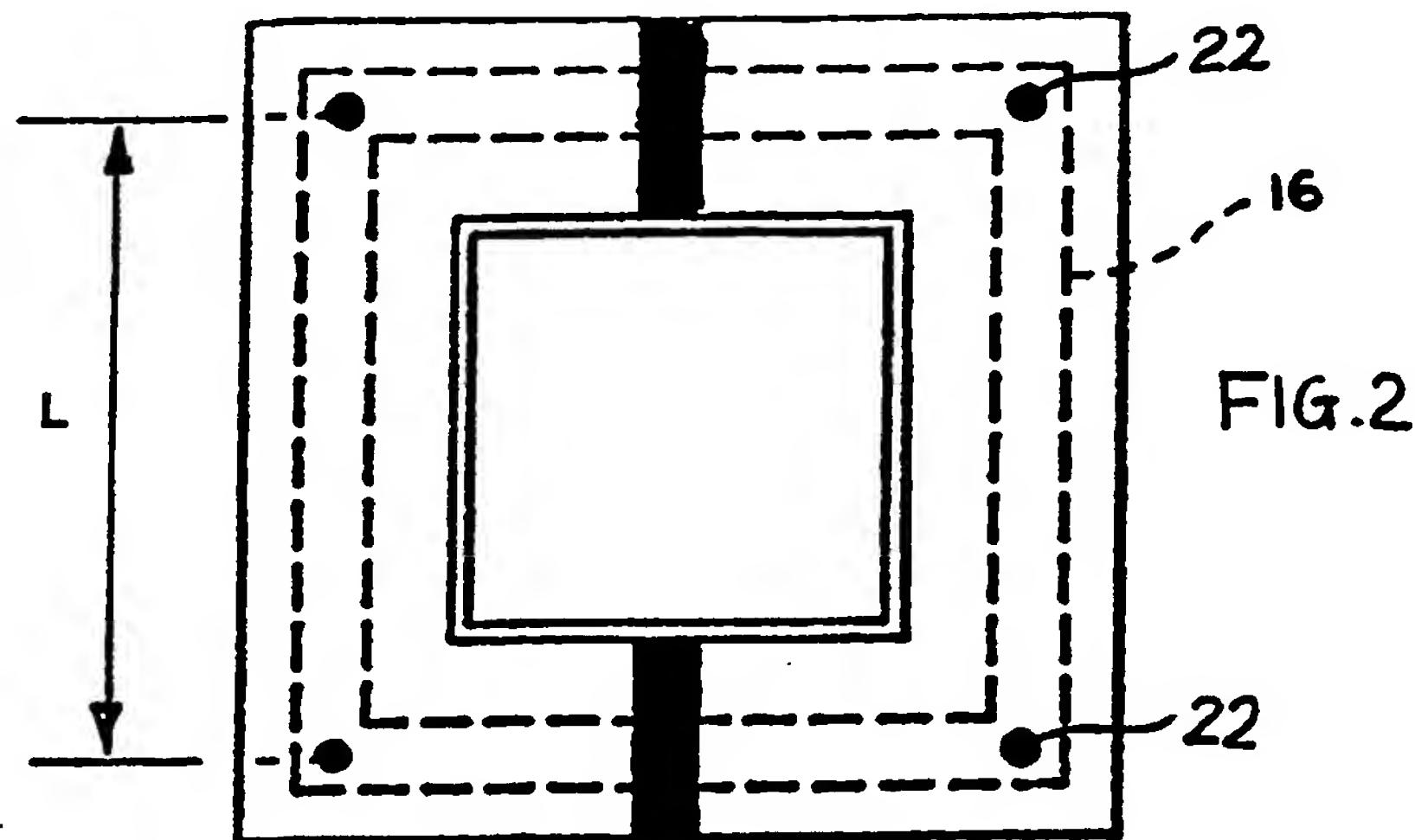
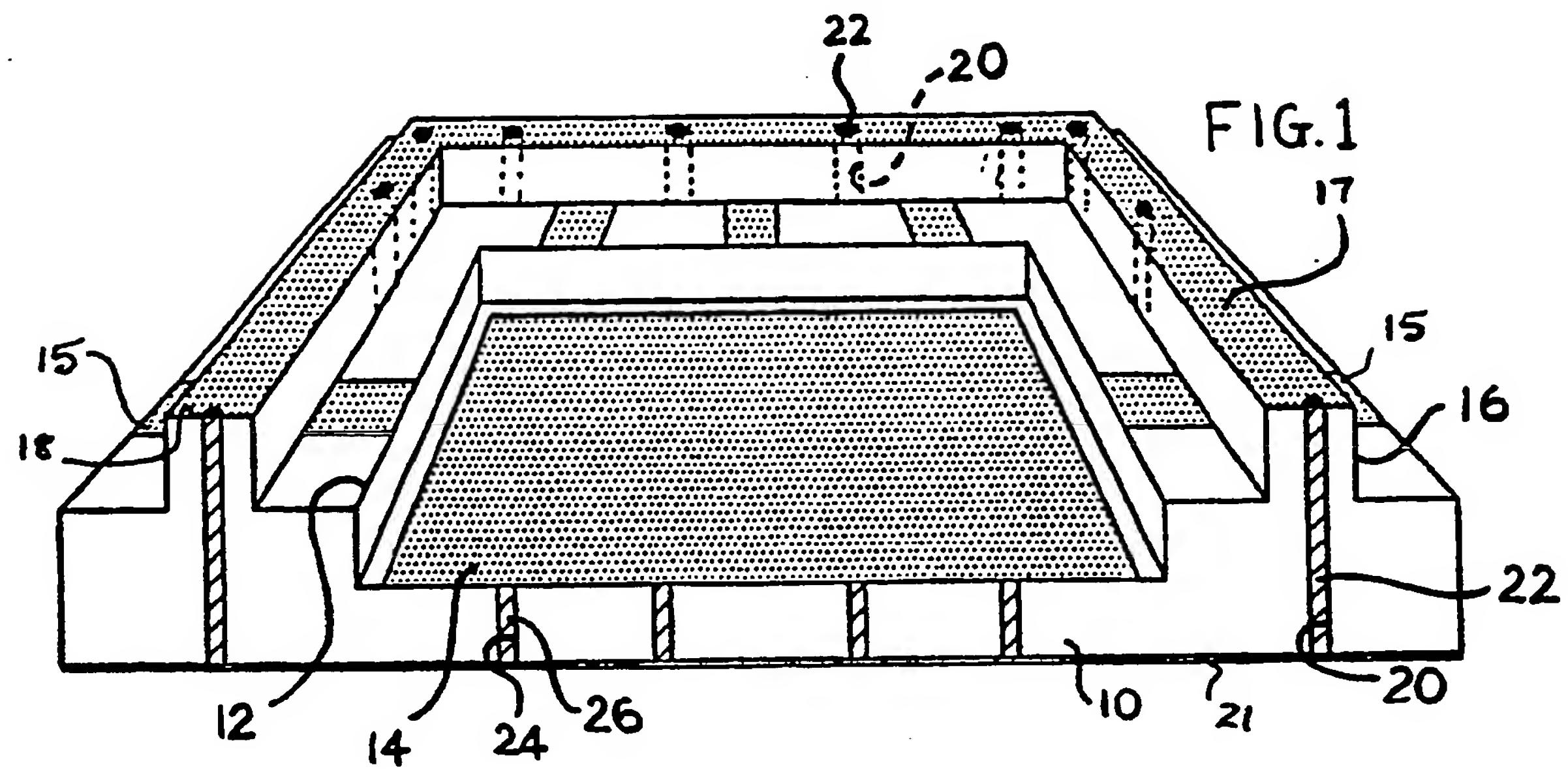
45

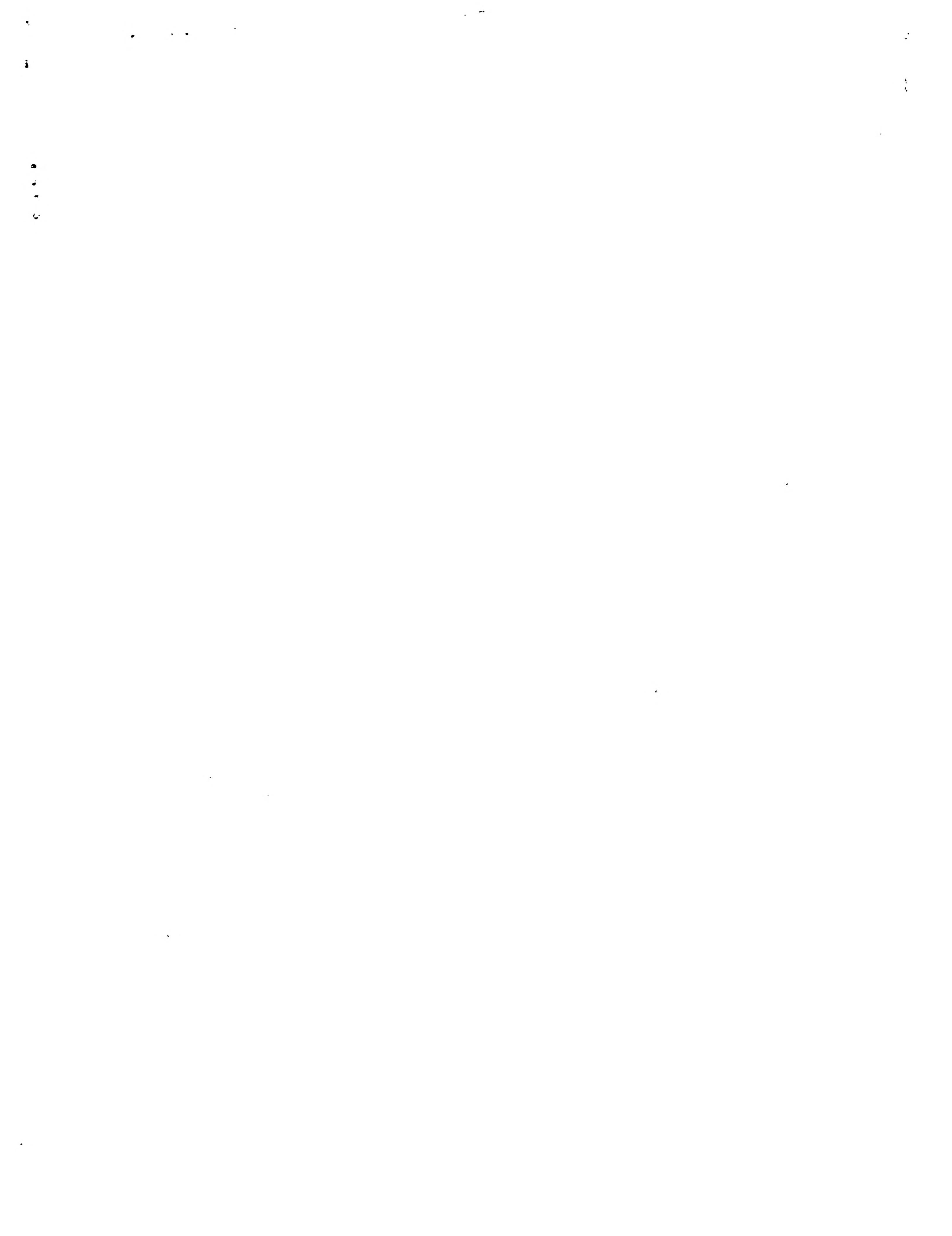
50

55

## Claims

1. A. ceramic package component comprising a







(19) Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) Publication number: 0 408 228 A3

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number: 90307207.2

(51) Int. Cl. 5: H01L 23/66, H01L 23/498,  
H01L 23/057, H01L 23/13

(22) Date of filing: 02.07.90

(30) Priority: 11.07.89 GB 8915827

(43) Date of publication of application:  
16.01.91 Bulletin 91/03

(84) Designated Contracting States:  
DE FR GB

(88) Date of deferred publication of the search report:  
25.03.92 Bulletin 92/13

(71) Applicant: OXLEY DEVELOPMENTS CO., LTD.  
Priory Park

Ulverston Cumbria LA12 9QG(GB)

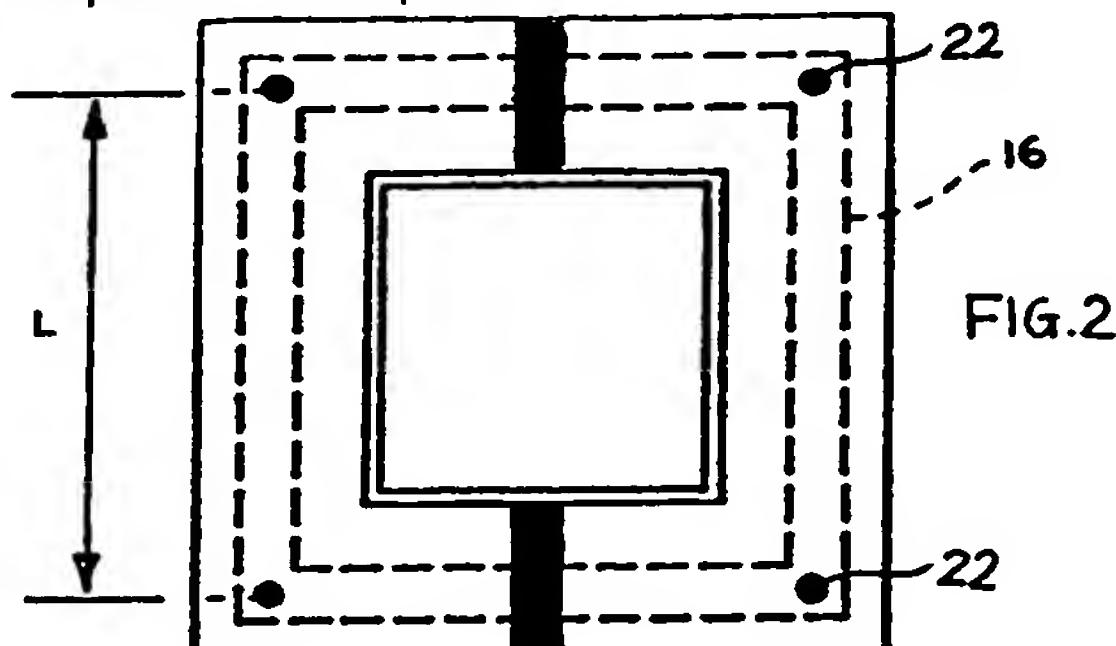
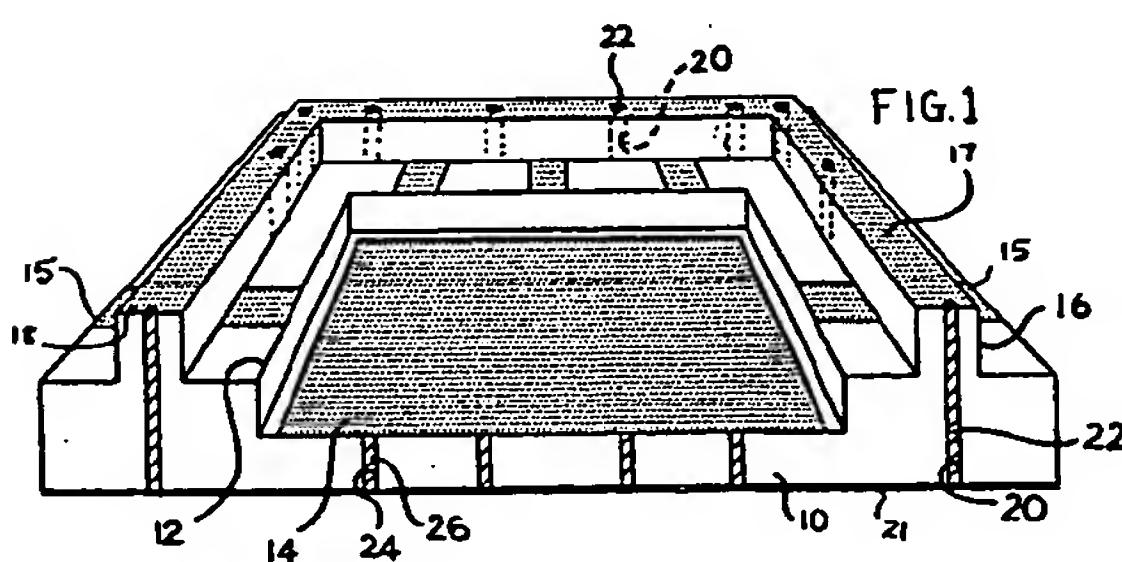
(72) Inventor: Chambers, Jeffrey, Dr.  
Bay Cottage, Main Street, Baycliffe  
Nr. Ulverston, Cumbria, LA12 9RN(GB)  
Inventor: Smith, David John  
Roundtre, Fernleigh Road  
Grange-Over-Sands, Cumbria, LA11 7HT(GB)

(74) Representative: Huntingford, David Ian et al  
W.P. THOMPSON & CO. Coopers Building  
Church Street  
Liverpool L1 3AB(GB)

### (54) Ceramic package and component.

(57) A ceramic package component has a base portion (10) and an upstanding enclosing wall (16) on the base portion (10), the upper surface (18) of the wall (16) being provided with an electrically conductive coating (17) in order to receive a lid sealingly thereon. The electrically conductive coating (17) on the upper surface of the wall (16) is electrically

connected to a further conductive coating (21) on the undersurface of the base portion (10) by means of a high density array of conductive vias (22) extending through the wall (16). The inter via spacing between adjacent vias (22) is preferably less than one quarter of the wavelength of the frequency at which the component is to operate.



EP 0 408 228 A3



EUROPEAN SEARCH  
REPORT

EP 90 30 7207

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 249 378 (FUJITSU LTD.) * the whole document ** - - -	1-3	H 01 L 23/66 H 01 L 23/498 H 01 L 23/057 H 01 L 23/13
X	PATENT ABSTRACTS OF JAPAN vol. 012, no. 351 (E-660)20 September 1988 & JP-A-63 108 756 ( SHINKO ELECTRIC IND CO LTD ) 13 May 1988 & US-A-4 890 155 (F. MIYAGAWA) * column 5, line 47 - column 6, line 2 *** column 6, line 42 - column 7, line 25; figures 10,15-18 ** - - -	1-3	
P,X	EP-A-0 331 289 (HITACHI LTD.) * the whole document ** - - -	1-3	
P,X	PATENT ABSTRACTS OF JAPAN vol. 013, no. 525 (E-850)22 November 1989 & JP-A-01 214 051 ( SUMITOMO ELECTRIC IND LTD ) 28 August 1989 * abstract ** - - -	1-3	
A	EP-A-0 309 942 (AMERICAN TELEPHONE & TELEGRAPH COMPANY) * the whole document ** - - -	1-3	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	EP-A-0 275 973 (SUMITOMO ELECTRIC IND LTD AND NIPPON TELEGRAPH AND TELEPHONE CORP.) * the whole document ** - - -	1,2	H 01 L
A	GB-A-2 172 440 (OXLEY DEVELOPMENTS CO LTD) * the whole document ** - - - -	1-3	

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	23 January 92	ZEISLER P.W.

CATEGORY OF CITED DOCUMENTS

- X: particularly relevant if taken alone
- Y: particularly relevant if combined with another document of the same category
- A: technological background
- O: non-written disclosure
- P: Intermediate document
- T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date

D: document cited in the application

L: document cited for other reasons

&: member of the same patent family, corresponding document